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EXCLUSIVE MEDICAL REPRESENTATIVES
INVENGINEERING, INC.
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THE OFFNER TYPE tc ELECTROENCEPHALOGRAPH

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OFFNER ELECTRONICS INC. / CHICAGO

THE OFFNER TYPE TC ELECTROENCEPHALOGRAPH

unmatched in performance

unequalled for operator convenience

outstanding in appearance

The complete superiority of the transistor electroencephalograph, using the exclusive Offner transistor circuits, has been proved in the six years since it was introduced, by the world-wide acceptance of the Offner Type T electroencephalograph. Now with the introduction of the Type TC electroencephalograph, an even more advanced instrument has become available for the clinical and experimental laboratory.

Convenience, performance, and appearance are all emphasized in the Type TC: *convenience* of control arrangement in a separate control console which can be positioned for greatest ease of manipulation; of ganged and individual setting of all filters, gains and inputs, a practical necessity when 16 channels are employed. *Performance* surpassing even the Type T, with exceptionally low noise level, high stability, high input impedance, and precision linearity and frequency response. *Appearance* which will add to any laboratory or office with its functional design, modern styling and soft coloring. The all-transistor amplifiers in the Type TC are dual plug-in modules, factory replaceable to eliminate substantially all electronic servicing in the field. All channels incorporate completely drift-free d-c amplifiers of high sensitivity, making any or all channels available for a wide variety of applications such as polygraphy, strain-gages, d-c bioelectric potentials, etc.

The Type TC may be obtained with two to 16 channels. Smaller assemblies may be expanded up to eight or 16 channels, as may be desired.

Why an all-transistor electroencephalograph? Transistors have provided such outstanding advantages that they are replacing vacuum tubes in almost every application where performance and reliability are of importance.

The potential advantages of transistors were recognized by Offner Electronics as soon as they became available, and an intensive program of transistor research was initiated almost ten years ago. As a result of this unequaled

experience, Offner Electronics has almost 100% transistorized its complete line of both medical and industrial instruments, with a consequent great improvement both in performance and reliability.

Of course it is not possible to merely replace vacuum tubes with a transistor, and obtain the full advantages of transistorization. A complete new technology of transistor use had to be developed, with many new, exclusive circuits. The transistorized electroencephalograph is designed as a complete entity; the design is dictated by the particular characteristics of transistors, from the input circuit to the recorder. Only in this way can the full advantages of transistorization be realized. Any other approach would not only result in a degradation of performance, but may actually result in an instrument inferior to the classic vacuum tube electroencephalograph. For example a "hybrid" EEG, using vacuum tubes in its first stage, retains the vacuum tube circuits which have always been the most troublesome in EEG maintenance. The Offner Type TC transistorized electroencephalograph uses no vacuum tubes, and obtains the greatest advantage from the use of transistors.

ADVANTAGES

The Type TC electroencephalograph has many advantages for both clinical and experimental applications. Some of these features are described below.

Reliability is of paramount importance to all users. The highly developed transistorized circuits of the Type TC have much higher reliability than is possible in any vacuum tube instrument for several reasons. The transistors themselves have practically unlimited trouble-free life, in contrast to vacuum tubes which inevitably require eventual replacement. Trouble due to noisy first stage tubes, the most frequent cause of difficulty in the conventional EEG, is completely eliminated, and the circuits used in the Type TC practically eliminate transistor noise as a possible source of difficulty. Furthermore, the low voltages employed with transistors and the low power dissipation in all circuits makes failure of other components in the circuits very much less probable. Actual experience shows that transistorized electroencephalographs are now at least ten times as reliable as the best of vacuum tube instruments.

Ease of maintenance is especially of importance to users in remote locations, where electronic assistance is not available. The plug-in amplifiers reduce servicing to merely plugging in a new unit, in the unlikely event of difficulty. Amplifiers are replaced or repaired by the factory. If preferred, the amplifiers may be repaired by the user.

Performance. The Type TC is superior to *any* conventional EEG in every important respect: it has higher sensitivity, more faithful response to both low and high frequencies, superior linearity, freedom from baseline sway, a rejection ratio in excess of 10,000 independent of any balance requirement, with consequent high immunity to interference.

Instant Operation with no warm-up period. The Type TC is immediately ready for use. It is not necessary for the technician to wait 30 to 60 minutes for the instrument to warm up and stabilize its operation.

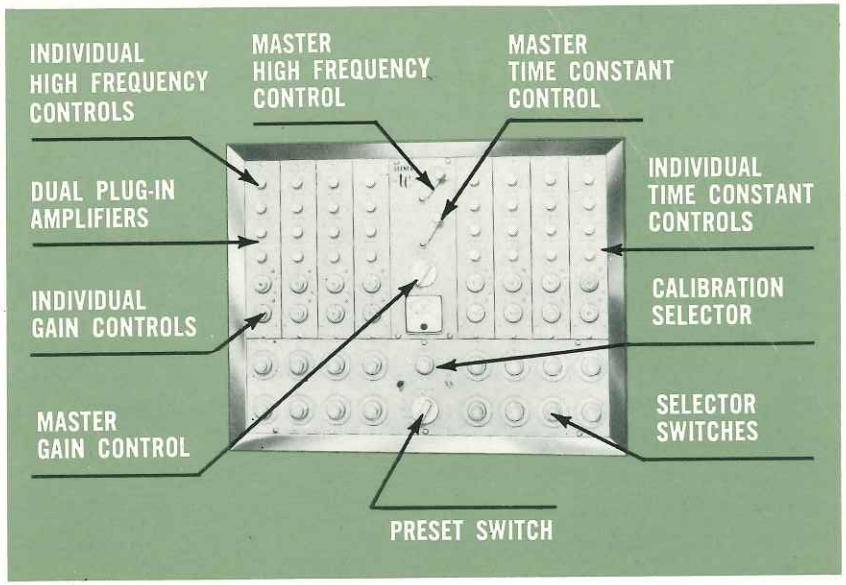
Economy of operation results from the lack of need for skilled maintenance personnel, frequent "down-time" for servicing, and the possible need for rerunning subjects as a result of instrument mal-function.

Versatility of application results from the d-c amplifier construction of the Type TC, together with its exceptionally wide range of response. This makes the instrument available for many other types of recording, besides clinical EEG.

CONSTRUCTION

Construction of the Type TC electroencephalograph is a complete departure from that employed on any previous instrument. It has been functionally designed to provide the greatest convenience in use for the operator.

The control console of the instrument is completely separate from the write-out and display console. This permits the controls to be placed at the most convenient position for the operator, where they may be set by the touch of a finger without the need



for reaching. At the same time the large visible area of record facilitates analysis of the tracing while it is being taken.

The control console contains the dual-channel plug-in amplifier units, as well as the calibrator-lead selector panel. The angle of the panel is readily adjustable, for most convenient operation with the operator either sitting down or standing.

The write-out unit contains the galvanometers, and also the highly regulated power supplies for the amplifiers, which are operated completely from the power lines.

A feature of the amplifier construction is the combination individual and ganged filter controls. Individual controls are provided on each amplifier for both the low and high frequency cut-off. Through an ingenious ganging system, the controls for all channels may be simultaneously set by a mechanical linkage. This makes it readily possible to insure that all channels are set to the same frequency response, and to change all settings simultaneously when it becomes desirable in taking a record.

Amplifiers The Type 455 amplifiers used in the Type TC are dual-channel units. They employ exclusive Offner-developed circuits, providing the highest degree of stability and wide frequency response. The input chopper circuit isolates the input circuit from ground, and provides the greatest resistance from outside interference as well as suppressing substantially all circuit noise. The chopper converts the low frequency electroencephalogram to a 400 cps wave, which is efficiently amplified, then reconverted back to its original waveform. The amplified waveform is filtered to give the selected frequency response, then further amplified by a high stability transistor power amplifier, to a power level sufficient to operate the pen writer units.

The Type 455 amplifiers are directly plug-in, and may be readily removed for servicing, or replacement if necessary.

Lead selector-calibrator Any desired combination of 24 electrodes may be selected by the duo-centric selector switches. In addition up to nine predetermined runs may be chosen by the preset selector switch.

Seven calibration microvoltages, from ten to 1,000 microvolts, accurate to within two percent are provided. Electrode resistance is measured by the panel meter, to insure electrodes are properly affixed.

Power Supply The all a-c operated power supply of the Type TC is contained in the foot pedestal of the writer unit. All preamplifier stages are supplied by highly regulated d-c, provided through transistor regulators employing a zener reference. The regulation is sufficient to permit operation of the Type TC over power line voltages fluctuating from as low as 95 to as high as 135 volts, without affecting the recording.

Dynograph The Dynograph write-out unit includes the Type 507 dual galvanometer units, with a precision paper drive. The highly efficient galvanometers employ a unique magnetic circuit, providing a very high magnetic field with minimum external flux. This minimizes the attraction of magnetic particles into the units, pre-

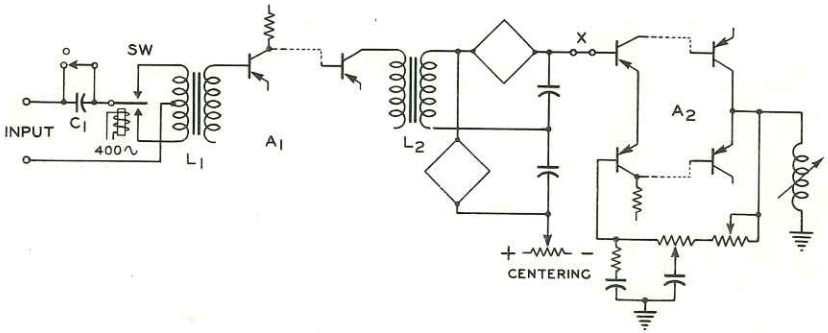
vents interaction between adjacent channels, and avoids the magnetization of external object. The galvanometers provide high linearity, and their high restoring force, 250,000 dynes at the pen tip per centimeter of deflection, makes hysteresis effect immeasurably small. The excellent high frequency response is assisted by the very light, but strong pens.

The precision paper drive is driven by a synchronous motor, insuring accuracy of paper travel. The standard model employs a three-speed motor, providing speeds of 1.25, 2.5, and 5 centimeters per second; or alternatively, 1.5, 3, and 6 centimeters per second. As an optional feature, either a seven or eight speed drive can be supplied, providing speeds from one to 100 or one to 250 millimeters per second respectively. For 16 channels, 16½ inch wide paper is employed, driven from both edges.

A large display area for the record is provided by the transparent table.

Technical Features Although an understanding of the electronic functioning of the Type TC is in no way necessary to the full enjoyment of its clinical use, some advance workers may find a brief description of the electronic design of the instrument of interest.

A simplified diagram of the Type 455 amplifier, as used in the Type TC, is shown in the accompanying illustration. The input signal, which may be d-c or the low frequency EEG, is applied to a vibrating chopper switch SW, and thus converted into a relatively high frequency (400 cps) square wave. This high frequency wave is efficiently coupled to the amplifier through transformer L_1. Transformer coupling has the very great advantage of providing true differential input: the input circuit is completely isolated from ground, and thus the differentiality is in no way dependent upon any circuit balance. This results in freedom from pick-up of interference artefact.



When d-c response is not desired, d-c is blocked from the input by capacitor C_1. This capacitor is short circuited when d-c response is desired. D-c response is of value for a wide variety of experimental purposes, as well as some clinical uses.

The output of the input transformer is amplified by a high gain, high stability transistor amplifier A_1. This amplifier employs special circuit techniques to give high stability of amplification, independent of transistor characteristics and room temperature. Its output is demodulated by a high precision demodulator circuit, originally developed for the Offner precision data amplifiers. This circuit features minimum output ripple, rapid response, and highly stable amplification.

The demodulated output of the preamplifier A_1 has again the waveform as the original signal, but amplified up to 1,000 times. This is further amplified by a high stability d-c transistor amplifier, A_2, which provides sufficient power to operate the Dynograph pen motors. Amplifier A_2 employs inverse feedback as illustrated, for several purposes. The feedback provides stable gain and high linearity. At the same time it permits control of both the amplification and frequency response.

Pen centering is provided by the centering control. This has sufficient range to permit the cancelling out of d-c components in input signals, which may be several times the desired signal amplitude. Since the centering control follows the preamplifier, its adjustment does not cause any reverse current to flow through the subject, and avoids interaction between recording channels connected to the same subject.

The d-c response of both the preamplifier A_1 and the power amplifier A_2 of the Type 455 amplifier makes the unit adaptable to a wide variety of types of recording other than conventional EEG. One application is the recording of d-c bioelectric potentials. However, the particular configuration of the amplifiers makes them adaptable to more complex applications as well. For this reason provision is made for coupling externally between the preamplifier and the power amplifier, at point "X". In the first four channels these terminals are brought out to an external receptacle, along with the power supply voltages, plus 15 volts, minus 15 volts, and 6 volts 400 cycles. This makes the amplifier useable with a variety of "input couplers" similar to those employed in the Type R laboratory Dynograph. These permit use of various types of strain-gage and differential transformer transducers for measurement of pressure, position, force, etc. Also available and directly useable are other input couplers such as cardiotachometer, EMG integrator, and electrometer input for such purposes as microelectrodes. An input coupler plug-in bin is available for use of such input couplers.

FULL SCALE, UNRETOUCHED RECORDS

SPECIFICATIONS

Number of Channels: Up to 16. Any lesser even number of channels can be provided. The console will be wired for either eight or 16 channels, as specified, permitting such eventual expansion.

PERFORMANCE

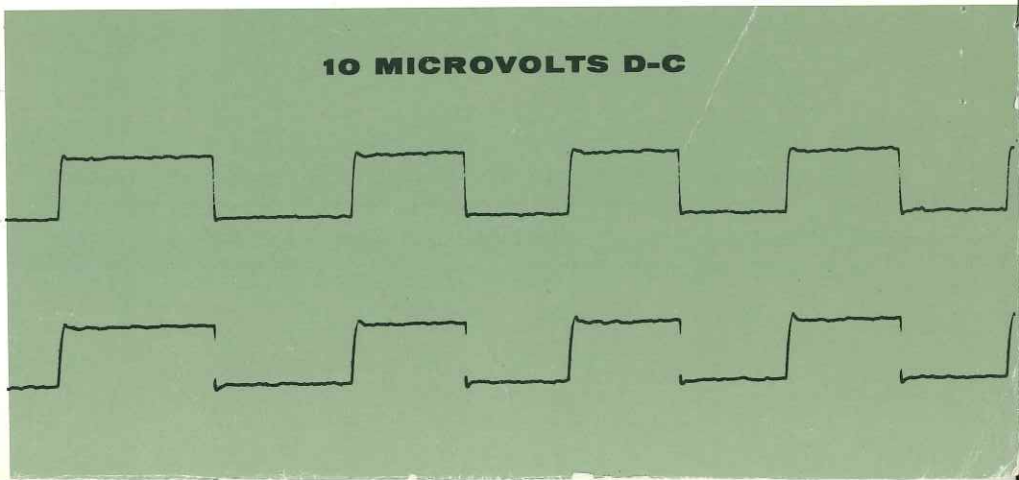
Sensitivity: One microvolt per millimeter maximum.
Noise Level: One microvolt maximum.
Frequency Response: Zero to 150 cps.
Pen Deflection: Five centimeters total.
Linearity: One percent per four cm.
Common-mode Balance: The rejection ratio is infinite for d-c, and in excess of 10,000 at 60 cps, independent of any circuit balance requirement.
Input Impedance: Two megohms.

CONTROLS

Time Constant: D-c, 1.0, 0.3, 0.1, and 0.03 seconds. Controls are individual for each channel, but are mechanically ganged so that all may be simultaneously set by a master control.
High Frequency: Three-position, giving high frequency cut-off at beyond 150 cps, and approximately 50 and 30 cps. Controls are individual for each channel, but are mechanically ganged for simultaneous operation by a master control when desired.
Gain: Three gain controls are provided: individual five-position step, and continuous "equalizer" for each channel; and a five-position master gain control for all channels.

LEAD SELECTION

Twenty-four Electrode Selection: twenty-four point duocentric selector switches for each channel. Nine preset combinations selectable by a single switch may be provided.



CALIBRATOR

Microvoltage Selection: Seven—10, 25, 50, 100, 250, 500 and 1,000 microvolts, 2% accuracy.

Resistance Meter: Measures resistance for all electrodes.

DYNOGRAPH

Oscillographs: Rotating 11-ohm coil, sapphire pivot with beryllium-copper torsion rod. Pen length, 4½ inches. Oscillographs are dual units with high magnetic flux, and are readily replaceable.

Paper Drive: Uses precision synchronous motor. Standard three-speed drive uses electrical speed shift, with speeds of 1.25, 2.5, and 5 centimeters per second; or alternative 1.5, 3, and 6 centimeters per second. Special alternative drives available with seven speeds from one to 100 millimeters per second, or eight speeds, one to 250 millimeters per second. Paper width is 8½ inches for eight channels, and 16½ inches for 16 channels. Paper is in folded packs.

POWER SUPPLY

Regulated Supply: All preamplifier stages are supplied by a transistor regulated power supply giving plus 15 volts d-c and minus 15 volts d-c. The feedback regulator circuit makes the performance completely independent of any line voltage fluctuation over the range 95-135 volts 50 or 60 cps. A 400 cps oscillator supply is provided for operating the chopper and demodulator. This supply is also highly regulated.

Auxiliary Power: Terminals on the amplifier console provide plus 15 volts d-c, minus 15 volts d-c and 6 volts 400 cycles, for operation of auxiliary equipment such as energizing strain-gages and input couplers.

Other Line Voltages: A built-in auto-transformer is provided on order for operation on line voltages other than 105-130 volts.

MOUNTING

The Dynograph write-out unit occupies a floor space of 55 inches x 19 inches. The table height is 32 inches. The amplifier-control console occupies a floor space 32 inches x 22 inches, and is 46 inches high. Both units are mounted on ball casters, so that they may be moved as may be convenient about the laboratory.

Standard color of units is pastel green cabinet, color No. 24300. Panels are light grey, color No. 26492, Fed. Spec. 595. Lettering is black.

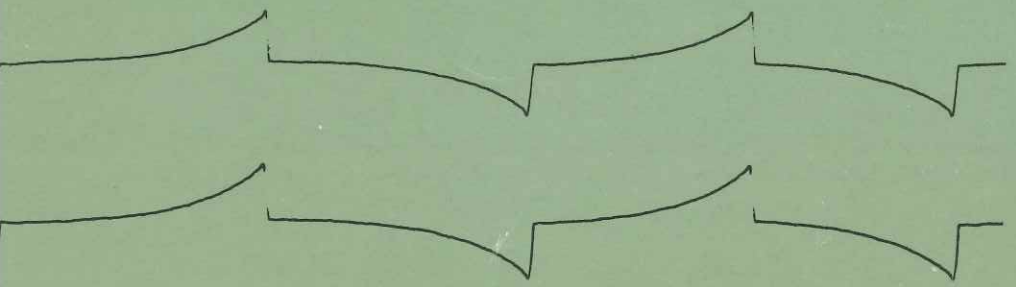
ACCESSORIES

Signal Pen: Signal marking pens may be provided at either or both edges of the paper, for marking stimuli, time, or for other purposes.

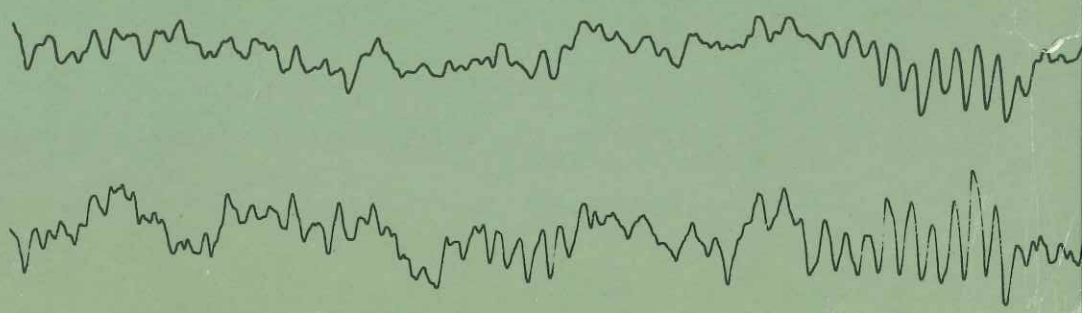
Input Couplers: Mounting bin available for up to four input couplers, permitting channels to be used for various auxiliary purposes. Several bins may be employed if a greater number of input couplers is desired. See separate listing of input couplers available.

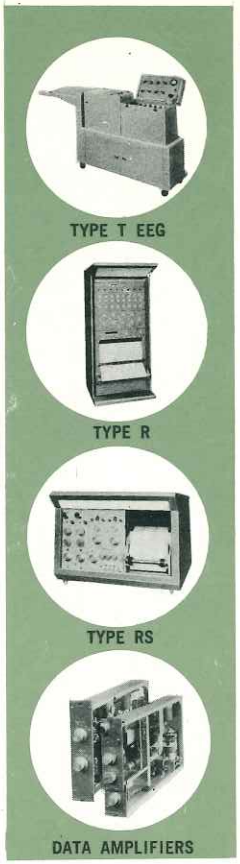
Warranty: The Type TC EEG is warranted to be free from all defects in materials or workmanship for a period of two years under the following terms: any plug-in component (amplifier, chopper, Dynograph, or power supply unit) will be repaired without charge, or at the option of the factory, replaced, provided the unit is returned to the factory, and the defect is not due to tampering or misuse.

50 MICROVOLTS CALIBRATION

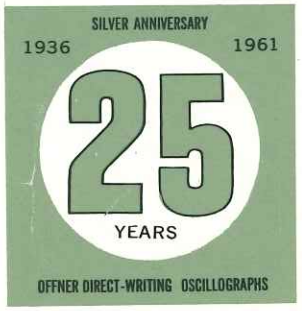


NORMAL EEG RECORDINGS





More than 25 years of design, development, and manufacturing experience are incorporated in the electronic equipment produced by Offner for industrial and medical use. Other Offner instruments of interest to the medical profession include the Type T Transistor Portable EEG, and the Type R and RS Dynographs, polygraphs of exceptional versatility and accuracy. Offner Data Amplifiers are used where precision amplification is required.



25 years ago Offner invented the world's first Direct-Writing Oscillograph.

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